

4. Animal Kingdom

Basis of classification:

1. Levels of Organization:

- A) Cellular level: sponges
Some division of labour among cells
- B) Tissue level: coelenterates
- C) Organ level: platyhelminths and higher

Organ system: annelids, arthropods, molluscs, echinoderms, chordates – organs associated to form functional system

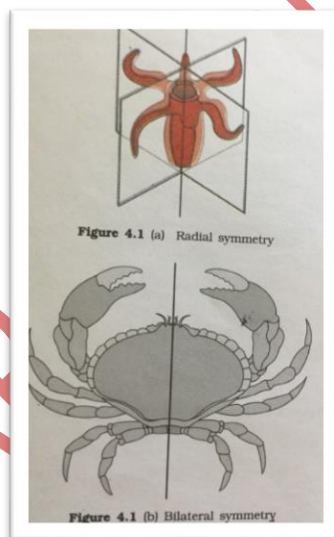
Digestive system in platyhelminths is incomplete because have only one opening acting as both mouth and anus.

2. Symmetry:

Asymmetric: sponges

Radial symmetry: (any plane through central axis) coelenterates, ctenophores, echinoderms

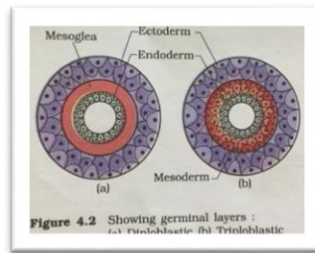
Bilateral symmetry: (identical left and right) annelids, arthropods



3. Arrangement of embryonic layers:

In two layers: external ectoderm and internal endoderm called as **diploblastic**.

E.g. coelenterates. Mesoglea an undifferentiated layer, between ectoderm and endoderm



Triploblastic: third germinal layer mesoderm between ecto and endo (platyhelminthes to Chordates)

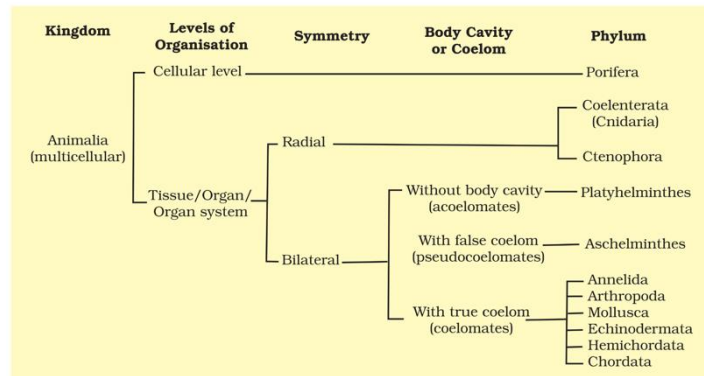


Figure 4.4 Broad classification of Kingdom Animalia based on common fundamental features

4. Coelom: presence or absence of a cavity between the body wall and the gut wall
Coelom: body cavity lined with mesoderm
Coelomates: annelids, molluscs, arthropods, echinoderms, hemichordates, chordates
Pseudocoelomates: scattered pouches with mesoderm : aschelminthes
Acoelomates: platyhelminthes

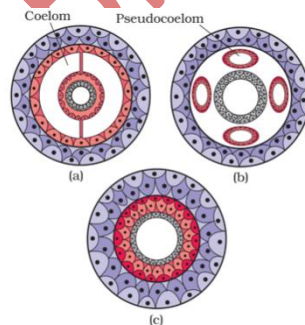


Figure 4.3 Diagrammatic sectional view of :
(a) Coelomate (b) Pseudocoelomate
(c) Acoelomate

5. Segmentation: metameric segmented body, earth worm
6. Notochord: mesodermally derived rod like structure
Non-chordates: porifera to echinoderms

Classification of animals:

1. Porifera: sponges

Marine	Asymmetric	Cellular level of Organization	Water canal system
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Water enters through **ostia** enters cavity (**spongocoel**) & comes out through **osculum**

Choanocytes lines the canal and cavity

Skeleton: spicules or spongin

Sexes: hermaphrodite (not separate)

Fertilisation: internal

Development: indirect through a morphologically different larva

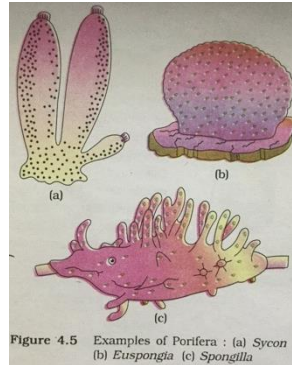


Figure 4.5 Examples of Porifera : (a) *Sycon* (b) *Euspongia* (c) *Spongilla*

Examples: sycon: scypha, spongilla: fresh water sponge, euspongia: bath sponge

2. Phylum Coelenterata: cnidaria

Aquatic marine	Sessile or free swim	Radial symmetry	Tissue level Organization
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Cnidoblast or cnidocytes (contain stinging capsules or nematocytes) on tentacles or body
Diploblastic

Central gastro vascular cavity with single opening, mouth on **hypostome**

Corals: calcium carbonate skeleton

Body form:

A) Polyp: sessile, cylindrical like hydra, adamsia

B) Medusae: umbrella shape, aurelia, jelly fish

Metagenesis: both forms, obelia: polyps produce medusae asexually and medusae produce polyps sexually

Ex. Physalia (Portuguese man of war), adamsia (sea anemone), pennatula (sea pen), gorgonia (sea fan), meandrine (brain coral)

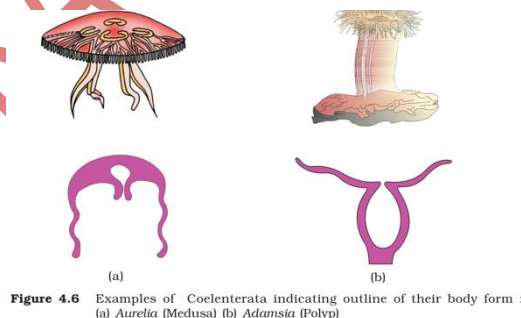


Figure 4.6 Examples of Coelenterata indicating outline of their body form : (a) *Aurelia* (Medusa) (b) *Adamsia* (Polyp)



Figure 4.7 Diagrammatic view of Cnidoblast

3. Ctenophora:

Sea walnuts or comb jellies

Marine	Radially symmetry	Diploblastic	Tissue level Organization
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Comb plates: eight external rows of ciliated on body for locomotive purpose

Bioluminescent
Hermaphroditism
Sexual reproduction
External fertilisation with indirect development
Ex. Pleurobrachia, ctenophora

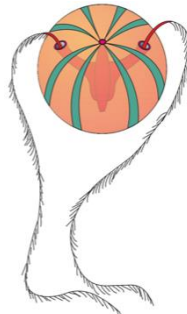


Figure 4.8 Example of Ctenophora (Pleurobrachia)

4. Platyhelminthes:
Flatworms-dorso ventrally flattened body
Endoparasites

Bilateral symmetry	Triploblastic	Acoelomates	Organ level Organization
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Hooks and suckers in parasitic form
Flame cells: osmoregulation & excretion
Hermaphrodite
Internal fertilisation through larval forms
Planaria: high regeneration capacity
Ex. Taenia (tape worm) , fasciola (liver fluke)

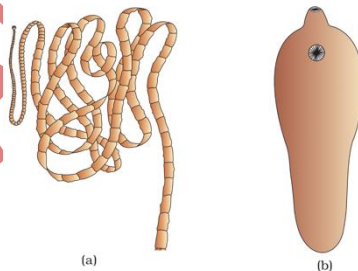


Figure 4.9 Examples of Platyhelminthes : (a) Tape worm (b) Liver fluke

5. Aschelminthes: roundworm

Aquatic or terrestrial or parasitic	Bilateral symmetry	Triploblast
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Muscular pharynx
Dioecious (separate sexes)
Internal fertilisation direct/ indirect development
Ex. Ascaris (round worm), wucheria (filaria worm), ancylostoma (hookworm)



Figure 4.10 Aschelminthes
– Roundworm

6. Annelida:

Marine or fresh	Triploblast coelomates	
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Body: segments or metamers

Nereis: aquatic possess **parapodia** for swimming, dioecious

Nephridia

Paired ganglia

Earthworm, leeches: monoecious

Ex. Nereis, pheretima (earthworm), hirudinaria (blood sucking leech)

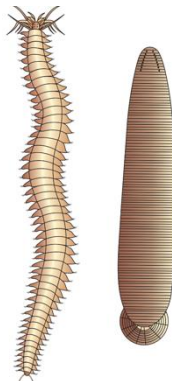


Figure 4.11 Examples of Annelida : (a) Nereis
(b) Hirudinaria

7. Arthropoda: largest phylum

Bilateral symmetry	Triploblastic	Organ system	Coelomate
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Segmented body

Chitinous exoskeleton

Jointed appendages

Respiratory organs: gills, book gills, book lungs or tracheal system

Open circulation

Statocysts or balance organs present

Excretion through malpighian

Most dioecious, mostly oviparous

Fertilisation internal

Development direct or indirect

Ex. Apis (honey bee), bombyx (silkworm), laccifer (lac insect)

Vectors: anopheles, culex & aedes (mosquitoes)

Gregarious pest: locusta

Living fossil: limulus (king crab)

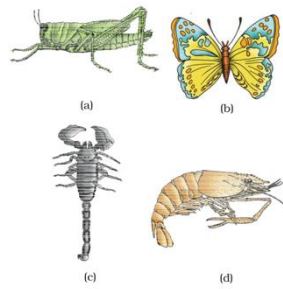


Figure 4.12 Examples of Arthropoda :
(a) Locust (b) Butterfly
(c) Scorpion (d) Prawn

8. Mollusca:

Second largest animal phylum

Terrestrial & aquatic	Organ system	Bilateral symmetry	Triploblastic
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Body covered with calcareous shell

Unsegmented with distinct head, muscular foot & visceral hump

Mantle: soft & spongy layer of skin

Feather like gills present in mantle cavity

Radula: mouth contains a file like rasping organ for feeding

Dioecious

Oviparous

Indirect development

Ex. Pila (apple snail), pinctada (pearl oyster), sepia (cuttlefish), loligo (squid), octopus (devil fish), aplysia (sea hare), dentalium (tusk shell), chaetopura (chiton)

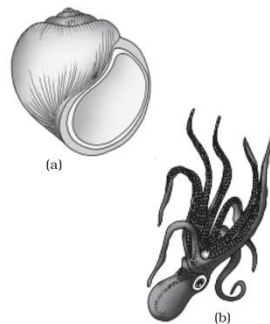


Figure 4.13 Examples of Mollusca :
(a) Pila (b) Octopus

9. Echinodermata: spiny bodied, endoskeleton of calcareous ossicle

Marine	Adult radial symmetry Larva bilateral	Triploblast
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Mouth on ventral side & anus on dorsal side

water vascular system

Separate sexes

Sexual reproduction

Fertilisation external

Indirect development through larva

Asterias (Star fish), Echinus (Sea urchin), Antedon (Sea lily), Cucumaria (Sea cucumber) and Ophiura (Brittle star)

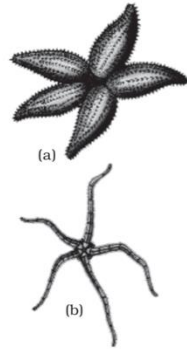


Figure 4.14 Examples for Echinodermata :
(a) *Asterias*
(b) *Ophiura*

10. Hemichordate: earlier considered as a sub-phylum under phylum Chordata.
Now: separate phylum under non-chordata.

Marine	Bilateral	Triploblastic	Coelomates
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Body: cylindrical, composed of an anterior proboscis, a collar and a long trunk
Sexual reproduction, fertilisation external, indirect development
Ex. *Balanoglossus* and *Saccoglossus*.

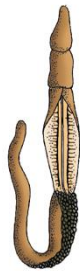


Figure 4.15 *Balanoglossus*

11. Chordata:
characterised by the presence of a notochord, a dorsal hollow nerve cord and paired pharyngeal gill slits

Bilateral	Triploblast	Coelomates
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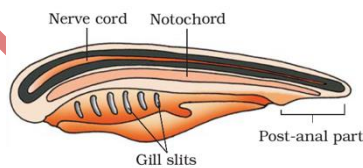


Figure 4.16 Chordata characteristics

Three subphyla:

- 1) Urochordata or tunicata
- 2) Cephalochordata
(both called protochordata, marine)
- 3) Vertebrata

TABLE 4.1 Comparison of Chordates and Non-chordates

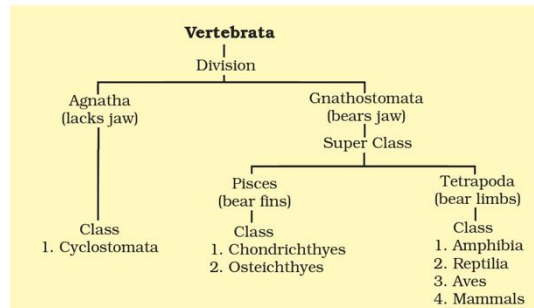
S.No.	Chordates	Non-chordates
1.	Notochord present.	Notochord absent.
2.	Central nervous system is dorsal, hollow and single.	Central nervous system is ventral, solid and double.
3.	Pharynx perforated by gill slits.	Gill slits are absent.
4.	Heart is ventral.	Heart is dorsal (if present).
5.	A post-anal part (tail) is present.	Post-anal tail is absent.

Urochordates: notochord in larval tail. Ascidia, Salpa, Doliolum.

Cephalochordata: notochord extends from head to tail, throughout life. Branchiostoma (Amphioxus or Lancelet).

Vertebrata: larval notochord replaced by vertebral column

The subphylum Vertebrata is further divided as follows:



- A) Class: cyclostomata
Ectoparasites on fishes
6-15 pair of gill slits
Devoid of scales
Cartilagenous skeleton
Ex. Petromyzon (Lamprey) and Myxine (Hagfish)



Figure 4.18 A jawless vertebrate - *Petromyzon*

- B) Class: chondrichthyes
Marine, cartilaginous, notochord throughout life
without operculum (gill cover)
Internal fertilisation
Skin is tough and contains minute placoid scales
Teeth are modified placoid scales
Some have electric organs (torpedo) & some possess poison sting (trygon)
Cold blooded: poikilothermous
Scoliodon (Dog fish), Pristis (Saw fish), Carcharodon (Great white shark), Trygon (Sting ray).

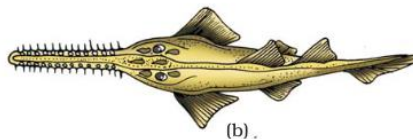


Figure 4.19 Example of Cartilaginous fishes :
(a) *Scoliodon* (b) *Pristis*

- C) Osteichthyes
Marine & fresh with bony endoskeleton
Gills covered by operculum
Two chambered heart
Skin covered with cycloid/ctenoid scales
Air bladder for buoyancy

External fertilisation

Oviparous

Ex. Marine – Exocoetus (Flying fish), Hippocampus (Sea horse); Freshwater – Labeo (Rohu), Catla (Katla), Clarias (Magur); Aquarium – Betta (Fighting fish), Pterophyllum (Angel fish).

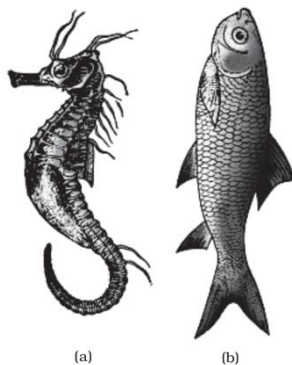


Figure 4.20 Examples of Bony fishes :
(a) *Hippocampus* (b) *Catla*

D) Amphibia:

Tympanum representing ear

Cloaca: alimentary canal, urinary and reproductive tracts open into a common chamber

Three chambered heart

Oviparous

External fertilisation

Ex. Bufo (Toad), Rana (Frog), Hyla (Tree frog), Salamandra (Salamander), Ichthyophis (Limbless amphibia).

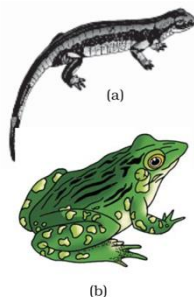


Figure 4.21 Examples of Amphibia :
(a) *Salamandra*
(b) *Rana*

E) Reptilia:

Dry cornified skin, epidermal scales or scutes,
do not have external ear openings

Three chambered heart

Internal fertilisation

Oviparous

Ex. Chelone (Turtle), Testudo (Tortoise), Chameleon (Tree lizard), Calotes (Garden lizard), Crocodilus (Crocodile), Alligator (Alligator). Hemidactylus (Wall lizard), Poisonous snakes – Naja (Cobra), Bangarus (Krait), Vipera (Viper).

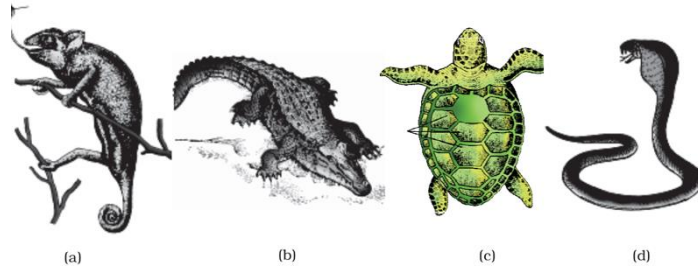


Figure 4.22 Reptiles : (a) *Chameleon* (b) *Crocodilus* (c) *Chelone* (d) *Naja*

F) Aves:

Feathers, beak

Forelimbs modified into wings

Hind limbs generally have scales

Skin dry except oil gland @ the base of the tail

Long hollow bones with air cavities (pneumatic)

Digestive tract of birds have additional chambers, the crop and gizzard

Four chambered heart

Warm blooded : homoiothermous

Able to maintain body temperature

Ex. *Corvus* (Crow), *Columba* (Pigeon), *Psittacula* (Parrot), *Struthio* (Ostrich), *Pavo* (Peacock), *Aptenodytes* (Penguin), *Neophron* (Vulture)

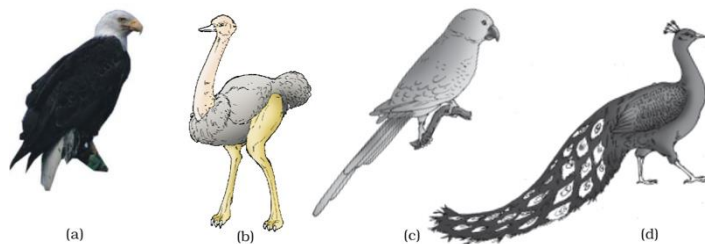


Figure 4.23 Some birds : (a) *Neophron* (b) *Struthio* (c) *Psittacula* (d) *Pavo*

G) Mammalia:

Presence of milk producing mammary glands

Possess hair, external ear or pinnae

Four chambered heart

Ex. Oviparous-*Ornithorhynchus* (Platypus); Viviparous -*Macropus* (Kangaroo), *Pteropus* (Flying fox), *Camelus* (Camel), *Macaca* (Monkey), *Rattus* (Rat), *Canis* (Dog), *Felis* (Cat), *Elephas* (Elephant), *Equus* (Horse), *Delphinus* (Common dolphin), *Balaenoptera* (Blue whale), *Panthera tigris* (Tiger), *Panthera leo* (Lion).

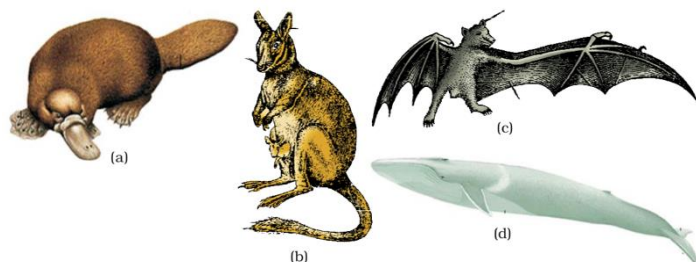


Figure 4.24 Some mammals : (a) *Ornithorhynchus* (b) *Macropus* (c) *Pteropus* (d) *Balaenoptera*

TABLE 4.2 Salient Features of Different Phyla in the Animal Kingdom

Phylum	Level of Organisation	Symmetry	Coelom	Segmentation	Digestive System	Circulatory System	Respiratory System	Distinctive Features
Porifera	Cellular	Many	Absent	Absent	Absent	Absent	Absent	Body with pores and canals in walls.
Coelenterata (Cnidaria)	Tissue	Radial	Absent	Absent	Incomplete	Absent	Absent	Cnidoblasts present.
Ctenophora	Tissue	Radial	Absent	Absent	Incomplete	Absent	Absent	Comb plates for locomotion.
Platyhelminthes	Organ & Organ-system	Bilateral	Absent	Absent	Incomplete	Absent	Absent	Flat body, suckers.
Aschelminthes	Organ-system	Bilateral	Pseudo coelomate	Absent	Complete	Absent	Absent	Often worm-shaped, elongated.
Annelida	Organ-system	Bilateral	Coelomate	Present	Complete	Present	Present	Body segmentation like rings.
Arthropoda	Organ-system	Bilateral	Coelomate	Present	Complete	Present	Present	Exoskeleton of cuticle, jointed appendages.
Mollusca	Organ-system	Bilateral	Coelomate	Absent	Complete	Present	Present	External skeleton shell usually present.
Echinodermata	Organ-system	Radial	Coelomate	Absent	Complete	Present	Present	Water vascular system, radial symmetry.
Hemichordata	Organ-system	Bilateral	Coelomate	Absent	Complete	Present	Present	Worm-like with proboscis, collar and trunk.
Chordata	Organ-system	Bilateral	Coelomate	Present	Complete	Present	Present	Notochord, dorsal hollow nerve cord, gill slits with limbs or fins.